ZETA MATHS

National 5

Applications of Mathematics

Learning Checklist

This checklist covers every skill that learners need for success at National 5 Applications of Mathematics. Each section of this checklist corresponds to the **Zeta Maths National 5 Applications of Mathematics** textbook (available from shop.zetapress.co.uk or Amazon). The topic names in this document are linked for easy navigation of the checklist and colour coded to correspond with skills: **numeracy**, **managing finance & statistics** and **geometry & measure**. Some section numbers are missing as these correspond to revision chapters in the textbook.

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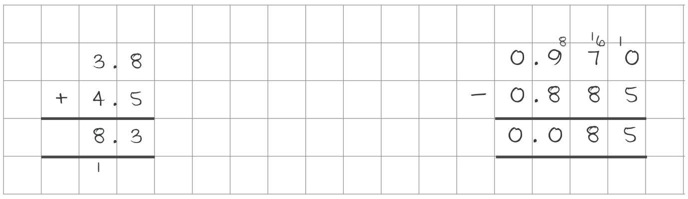
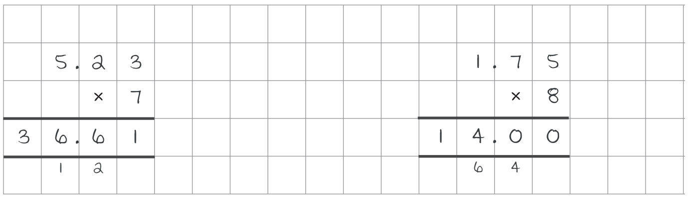
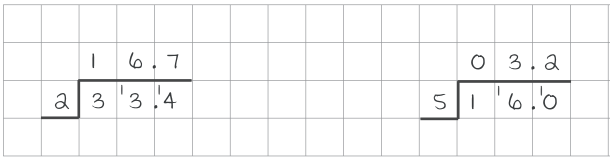
Section	**Topic**	**Skills**	🟥	🟨	🟩
1	**Rounding**				
1.1	Rounding to one, two or three decimal places	When rounding, it is only the number immediately to the right of the number being rounded that we consider. **(a)** 4.269 = 4.3 (1 d.p.) **(b)** 5.393 = 5.39 (2 d.p) **(c)** 8.4996 = 8.500 (3 d.p)			
1.2	Rounding to one, two or three decimal places	Numbers that are significant are numbers that fall after the first non-zero number that are not merely place holders. **(a)** 0.2695 = 0.3 (1 s.f.) **(b)** 0.2695 = 0.27 (2 s.f.) **(c)** 0.2695 = 0.270 (3 s.f.) **(d)** 59,208 = 60,000 (1 s.f.) **(e)** 59,208 = 59,000 (2 s.f.) **(f)** 59,208 = 59,200 (3 s.f.)			
2	**Whole Numbers**				
2.5	Multiplication by multilples of 10, 100 and 1000	To multiply by 10, 100 or 1000, we move the numbers **one**, **two** or **three places** to the **left**. Instead of trying to move all the numbers, move one number and the rest will follow. Keep the digits in the same order. **(a)** 34 × 200 = 34 × 2 × 100 = 68 × 100 = 6800 **(b)** 28 × 400 = 28 × 4 × 100 = 112 × 100 = 11 200			
2.6	Division by multilples of 10, 100 and 1000	To divide by 10, 100 or 1000, we move the numbers **one**, **two** or **three places** to the **right**. Instead of trying to move all the numbers, move one number and the rest will follow. Keep the digits in the same order. **(a)** 580 ÷ 20 = (580 ÷ 10) ÷ 2 = 58 ÷ 2 = 29 **(b)** 7200 ÷ 400 = (7200 ÷ 100) ÷ 4 = 72 ÷ 4 = 18			
3	**Decimal Numbers**				
3.1	Addition and subtractionof decimal numbers	**Worked Examples:** **(a)** 3.8 + 4.5 **(b)** 0.97 – 0.885 			
3.2	Multiplication of a decimal number by a whole number	**Worked Examples:** **(b)** 5.23 × 7 **(b)** 1.75 × 8 			
3.3	Division by a whole number	**Worked Examples:** **(a)** 33.4 ÷ 2 **(b)** 16 ÷ 5 			

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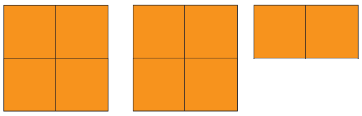
3.5	Multiplication by Multiples of 10, 100 and 1000	To **multiply** a decimal number by a multiple of **10**, **100** or **1000**, multiply the number by the multiple, then multiply by 10, 100 or 1000. **(a)** 3.4 × 20 = (3.4 × 2) × 10 = 6.8 × 10 = 68 **(b)** 3.5 × 400 = (3.5 × 4) × 100 = 14 × 100 = 1400			
3.8	Division by Multiples of 10, 100 and 1000	To **divide** a decimal number by a multiple of **10**, **100** or **1000**, divide by 10, 100 or 1000, then divide the number by the multiple. **(a)** 1.6 ÷ 20 = (1.6 ÷ 10) ÷ 2 = 0.16 ÷ 2 = 0.08 **(b)** 4.8 ÷ 400 = (4.8 ÷ 100) ÷ 4 = 0.048 ÷ 4 = 0.012			
4	**Fractions**				
4.1	Simplifying fractions	To **simplify** fractions we divide the **numerator** and **denominator** by the **same** number. **Worked Examples:** Simplify each of the following: **(a)** $\frac{2}{4}\begin{matrix}\div 2\\ \div 2\end{matrix}$ $= \frac{1}{2}$ **(b)** $\frac{10}{30}\begin{matrix}\div 10\\ \div 10\end{matrix}$ $= \frac{1}{3}$ **(c)** $\frac{8}{12}\begin{matrix}\div 4\\ \div 4\end{matrix}$ $= \frac{2}{3}$			
4.2	Changing improper fractions to mixed numbers	An **improper fraction** or a **top-heavy fraction** is a fraction with a larger number on the top (numerator) than the bottom (denominator). A **mixed number** is a number with a whole number part and a fractional part. **(a)** $\frac{14}{3} = 4\frac{2}{3}$ (14 ÷ 3 = 4 remainder 2) **(b)** $\frac{32}{5} = 6\frac{2}{5}$ (32 ÷ 5 = 6 remainder 2)			
4.3	Changing mixed numbers to improper fractions	**Worked Examples:** **(a)** $4\frac{1}{5} = \frac{4 \times 5 + 1}{5} = \frac{21}{5}$ **(b)** $3\frac{2}{7} = \frac{3 \times 7 + 2}{7} = \frac{23}{7}$			
4.4	Stating the number of fractional parts	**Worked Example:** How many quarters are there in $2\frac{1}{2}$?  $\frac{10}{4}$ = 10 quarters			
4.5	Finding a fraction of a whole number or quantity	**Worked Examples:** **(a)** Find $\frac{1}{3}$ of 12. $\frac{1}{3} \times 12$ $= 12 \div 3$ $= 4$ **(b)** Find $\frac{3}{4}$of 36. $\frac{3}{4} \times 36$ $= 36 \div 4 \times 3$ $= 9 \times 3$ $= 27$			
4.6	Adding and subtracting fractions	When adding or subtracting two or more fractions, make the denominators of the fractions the same using the **lowest common multiple** of the denominators. Multiply the numerator of the fraction by the same number as the denominator, then add the numerators together. **Worked Examples:** **(a)** $\frac{3}{4} + \frac{4}{5} = \frac{15}{20} + \frac{16}{20} = \frac{31}{20} = 1\frac{11}{20}$ **(b)** $\frac{5}{9} - \frac{1}{2} = \frac{10}{18} - \frac{9}{18} = \frac{1}{18}$			

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4.7	Expressing fractions as decimals	To express a fraction as a decimal without a calculator, it is best to make the denominator 10, 100, 1000, etc. We can then use our knowledge of place value to write the fraction in decimal form. **Worked Examples:** **(a)** $\frac{1}{5}$ multiply by 2 $= \frac{2}{10}$ $= 0.2$ **(b)** $\frac{1}{8}$ multiply by 12.5 $= \frac{12.5}{100}$ multiply by 10 $= \frac{125}{1000}$ $= 0.125$			
4.8	Expressing decimals as fractions	To express a decimal as a fraction, we can use our knowledge of place value, then simplify. **Worked Examples:** Express the following decimals as fractions: **(a)** 0.05 5 hundredths $= \frac{5}{100}$ divide by 5 $= \frac{1}{20}$ **(b)** 0.14 14 hundredths $= \frac{14}{100}$ divide by 2 $= \frac{7}{50}$			
4.9	Determining which fraction is greater	**Worked Examples:** **(a)** Which is greater: $\frac{3}{4}$ or $\frac{7}{12}$? $\frac{3}{4} = \frac{9}{12}$ $\frac{9}{12} > \frac{7}{12}$ $\therefore \frac{3}{4}$ is greater. **(b)** Which is greater: $\frac{36}{42}$ or $\frac{40}{56}$? $\frac{36}{42} = \frac{6}{7}$ and $\frac{40}{56} = \frac{5}{7}$ $\frac{6}{7} > \frac{5}{7}$ $\therefore \frac{36}{42}$ is greater.			
5	**Percentages**				
5.1	Expressing a percentage as a fraction	To express a percentage as a fraction, write the percentage as a number with a denominator of 100, then simplify. **Worked Examples:** Express each percentage as a fraction: **(a)** $20\% = \frac{20}{100} = \frac{1}{5}$ **(b)** $54\% = \frac{54}{100} = \frac{27}{50}$			
5.2	Expressing a fraction as a percentage	To express a fraction as a percentage *without* a calculator, make the denominator 100 using equivalent fractions. We can then write the number as a percentage. **Worked Examples:** **(a)** $\frac{3}{5}$ multiply by $\frac{20}{20}$ $= \frac{60}{100}$ $= 60\%$ **(b)** $\frac{5}{40}$ multiply by $\frac{10}{10}$ $= \frac{50}{400}$ divide by $\frac{4}{4}$ $= 12.5\%$			
5.3		**Worked Examples:** Express 38 as a percentage of 60. $\frac{\mathbf{38}}{\mathbf{60}} = \mathbf{38} \div \mathbf{60} \times 100(\%) = 63.33... = 63.3\%$ (1 d.p.)			
5.4	Expressing a percentage as a decimal	To express a percentage as a decimal, divide it by 100. **Worked Examples:** **(a)** $15\% = 15 \div 100 = 0.15$ **(b)** $3\% = 3 \div 100 = 0.03$			
5.5	Expressing a decimal as a percentage	To express a decimal as a percentage, multiply it by 100%. **Worked Examples:** **(a)** $0.3 = 0.3 \times 100(\%) = 30\%$ **(b)** $0.04 = 0.04 \times 100(\%) = 4\%$			

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5.6	Calculating a percentage of a number of quantity	**Worked Examples:** Find the following percentages **without using a calculator**: **(a)** 40% of 56 100% = 56 10% = 5.6 **40% = 22.4** **(b)** 15% of 68 100% = 68 **10% = 6.8** **5% = 3.4** **15% = 10.2** Find the following percentages **using a calculator**: **Worked Examples:** **(c)** Find 12% of 85. 0.12 × 85 = 10.2 **(d)** Find 28% of 146. 0.28 × 146 = 40.88			
5.9	Compound percentage increase and decrease	**Worked Examples:** **(a)** An investment of £800 appreciates at a rate of 5% per annum. How much will the investment be worth after 3 years? **Step 1:** Calculate the multiplier as a decimal: 100% + 5% = 105% = 1.05 **Step 2:** Use the multiplier three times: 800 × 1.05 × 1.05 × 1.05 = 800 × 1.05^3 = £926.10			
6	**Ratio & Proportion**				
6.1	Simplifying ratios	Ratios can be simplified in the same way as fractions, by dividing each number by the *same* number, ideally, the **highest common factor**. We should always simplify ratios before sharing. **Worked Examples:** Simplify the following ratios: **(a)** 18 : 30 divide by 6 3 : 5 **(b)** 75 : 120 divide by 15 5 : 8			
6.2	Sharing ratios	A ratio divides a quantity into a certain number of parts that are then shared in the given ratio. If the ratio can be simplified, simplify before sharing. **Worked Example:** Share 90 in the ratio 3 : 2. **Step 1:** Determine the number of parts. 3 + 2 = 5 parts **Step 2:** Calculate the value of one part. 1 part = 90 ÷ 5 = 18 **Step 3:** Share in the given ratio. 3 ×18 : 2 ×18 **54 : 36**			
6.3	Using ratios	**Worked Example:** A and B are in the ratio **3** : **4**. If A is 420, what is the value of B? **Step 1:** Calculate the value of one part. 1 part = 420 ÷ **3** = 140 **Step 2:** Multiply by 4 to find value of B. 140 × **4** = 560			
6.4	Direct proportion	**Worked Example:** Kirk is paid £25.50 for 5 hours work. How much will he be paid for 9 hours work? **Step 1:** Write down how much he earns for 5 hours: 5 hours £25.50 **Step 2:** Calculate how much he earns for 1 hour (÷ 5): 1 hour £5.10 **Step 3:** Multiply 1 hour by 9 (× 9) 9 hours £45.90 **Step 4:** Answer the question He will be paid £45.90.			

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6.5	Inverse (indirect) proportion	**Worked Example:** It takes three workers 12 hours to complete a job. How long will it take nine workers, working at the same rate? **Step 1:** Write down how long it takes. **Step 1:** Write down how long it takes 3 workers. **Step 2:** Calculate how long it takes 1 worker. **Step 3:** Divide 36 hours by 9 workers. **Step 4:** Answer the question. **Workers** **Time** $3 \longrightarrow 12$ hours $(\div 3)$ $(\times 3)$ $1 \longrightarrow 36$ hours $(\times 9)$ $(\div 9)$ $9 \longrightarrow 4$ hours It will take 9 workers 4 hours.			
7	**The Order of Operations and Using a Calculator**				
7.1	Simple operations	**BIDMAS** means **B**rackets, **I**ndices (powers), **D**ivide, **M**ultiply, **A**dd, **S**ubtract. **Worked Example:** $4 \times 5 - 9 \div 3$ $\mathbf{4 \times 5} - 9 \div 3$ $= \mathbf{20} - 3$ $= 17$			
7.2	Operations involving brackets	We must deal with any calculation that lies within brackets. **Worked Example:** $(5 + 9) \times 3$ $(\mathbf{5 + 9}) \times 3$ $= \mathbf{14} \times 3$ $= 42$			
7.3	Using a calculator	**Important buttons:** The fraction button, $\frac{\blacksquare}{\square}$, allows us to input fractions. The brackets buttons: (and). The square button: x^2. The power button: $x^{\blacksquare}$ and the square root button: $\sqrt{\blacksquare}$. The left and right arrow buttons, normally at the top centre of the calculator, are also important for moving in and out of each of these functions.			
7.4	Calculations involving inequalities	**Worked Example:** Use the inequality symbols to write an accurate statement about the following calculation: 654×298 and $\frac{2}{5}$ of 562 000 $654 \times 298 = 194\,892$ $\frac{2}{5}$ of 562 000 = 224 800 $194\,892 < 224\,800$ $\therefore\ 654 \times 298 < \frac{2}{5}$ of 562 000			
8	**Speed, Distance & Time**				
8.1	Converting distance units	**Larger to Smaller unit (Multiply)** Kilometres to metres (×1000) Metres to centimetres (×100) Centimetres to millimetres (×10) **Smaller to Larger unit (Divide)** Metres to km (÷1000) Centimetres to m (÷100) Millimetres to cm (÷10) **Worked Examples:** **(a)** Change 65 cm to millimetres $65 \div 10 = 6.5$ mm **(b)** Change 435 mm to metres $435 \div 10 = 43.5$ cm $43.5 \div 100 = 0.435$ m			

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8.2	Converting time units	**Larger to Smaller unit (Multiply)** Hours to minutes (× 60) Minutes to seconds (× 60) **Smaller to Larger unit (Divide)** Minutes to hours (÷ 60) Seconds to minutes (÷ 60) **Worked Example:** Change 18 seconds to minutes without a calculator: $= \frac{18}{60}$ minutes $= \frac{3}{10}$ minutes = 0.3 minutes With a calculator, when changing to decimal hours, round to two decimal places for minutes, but four decimal places for seconds.			
8.3	Converting speed units	Speed units are a combination of distance and time units. To convert speed units, convert the distance and the time units individually **Worked Example:** Change 18 m/s to km/h = (18 × 60) m/minute = (18 × 60 × 60) m/h = 64 800 m/h = 64 800 ÷ 1000) km/h = 64.8 km/h			
8.4	Calculating speed	**Speed = $\frac{\text{distance}}{\text{time}}$** or **S = $\frac{D}{T}$**. **Worked Example:** An object travels 18 miles and takes 24 minutes. Calculate the average speed of the object in miles per hour. **Step 1:** Identify units. D = 18 miles $T = \frac{24}{60} = 0.4$ hours S = ? mph **Step 2:** Use formula. $S = \frac{D}{T}$ **Step 3:** Substitute values. $S = \frac{18}{0.4}$ **Step 4:** Answer, using correct units. S = 45 mph			
8.5	Calculating distance	**Distance = speed × time** or **D = ST**. **Worked Example:** A runner completes a training run. She runs for 35 minutes at a speed of 10.5 km/h. How far does she run? **Step 1:** Identify units. S = 10.5 km/h T = 35 ÷ 60 = 0.5833 hrs D = ? kilometres **Step 2:** Use formula. D = ST **Step 3:** Substitute values. D = 10.5 × 0.5833 **Step 4:** Answer, using correct units. D = 6.125 miles			
8.6	Calculating time	**Time = $\frac{\text{distance}}{\text{speed}}$** or **T = $\frac{D}{S}$**. **Worked Example:** A van travels 85 miles at 65 mph. Calculate the time taken for the journey in hours and minutes. **Step 1**: Identify units. D = 85 miles S = 65 mph T = ? miles **Step 2:** Use formula. $T = \frac{D}{S}$ **Step 3:** Substitute values. $T = \frac{85}{65}$ **Step 4:** Answer, using correct units. T = 1.30769... = 1 + (0.30769... × 60) = 1 hour 18.46 minutes			

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9	**Reading Scales**				
9.1	Reading scales	When reading scales, the first thing we do is check the gradation of the scale, i.e. we need to check how many increments (spaces) there are from one number to the next. To work out how much each increment is worth, divide the difference between successive numbers by the number of increments.			
9.2	Marking scales	Work out how much each increment is worth by dividing the difference between successive numbers by the number of increments. Then mark on the scale the requested value.			
10	**Probability**				
10.2	Calculating more complex probabilities	Select the relevant information from a given table or diagram and complete calculations to state the probability. **Step 1:** Identify the number of favourable outcomes **Step 2:** Determine the number of possible outcomes **Step 3:** Calculate the probability $P(\text{event}) = \frac{\text{Number of favourable outcomes}}{\text{Number of possible outcomes}}$			
10.3	Using probability	**Worked Example:** The probability of rain on any day in October is 0.61. How many days of rain are expected in October? **Step 1:** Multiply the probability by the numbers of trains. $31 \times 0.61 = 18.91 = 19$ (to nearest whole number) **Step 2:** Answer the question. 19 days of rain are expected in October.			
11	**Interpreting Graphical Data**				
11.1	Interpreting tables	Each question will present different data in a table. The question will require you to pick out the relevant data and answer questions based upon the data derived from the table. There is often more information given in the question itself to take into consideration when picking out data from the table.			
11.2	Interpreting stem and leaf diagrams	A stem and leaf diagram displays quantitative data broken into stem (first digit/s) and the leaves (last digits). We must be able to pick out key information and perhaps calculate the mean or median from the data. (see Chapter 19)			
11.3	Interpreting compound bar graphs	Compound bar graphs allow us to compare like-for-like data with two or more categories. These graphs have two or more sets of data side by side on the graph. We must be able to identify trends or answer questions based upon the information presented in the bar graph, including comparing quantities.			
11.4	Interpreting comparative line graphs	A comparative line graph allows us to compare two sets of data over the same length of time. These graphs have two or more sets of data plotted on the same graph. We must be able to identify key points in the line graph, identify trends or answer questions based upon the information presented in the graph.			

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11.5	Interpreting pie charts	When we are asked to calculate the value represented by a section of the pie chart given the angle and the *total* number of data: **Step 1:** Find the fraction by writing the angle over 360. **Step 2:** Multiply the fraction by the total amount. If the question is **non calculator**, simplify the fraction before multiplying. When we are asked to calculate the value represented by a section of the pie chart given the angle and *one* of the data values: **Step 1:** Identify the angle the data value given represents. **Step 2:** Use proportion to calculate the answer for the value in question.			
13	**Currency Conversion**				
13.1	Single currency conversion	When converting currencies, we are usually given the value of 1 unit of one currency compared with another. We multiply or divide by this other value. **Worked Example:** The exchange rate from Canadian Dollars (CAD) to pounds sterling (GBP) is 1 GDP = 1.79 CAD. To the nearest pound, how many pounds sterling would be exchanged for 970 CAD. **Solution:** 970 ÷ 1.79 = 541.899441 = £542			
13.2	Multiple currency conversions	**Worked Example:** David went on back-to-back holidays last summer. He exchanged £960 for euros (EUR). He spent 280 euros and exchanged the rest for US dollars (USD). He then spent $710. The exchange rate is 1 GBP = 1.21 EUR = 1.27 USD How many dollars does he have leftover? Give your answer to the nearest pence. **Solution:** **Step 1:** Calculate number of euros. 960 × 1.21 = 1161.6 EUR **Step 2:** Calculate leftover euros. 1161.6 – 280 = 881.6 EUR **Step 3:** Convert back to pounds. 881.6 ÷ 1.21 = £728.59504 **Step 4:** Convert pounds to dollars. 728.59504 × 1.27 = 925.315702 USD **Step 5:** Calculate leftover dollars. 925.315702 – 710 = 215.315702 = $215.32 leftover			
14	**Gross Income**				
14.1	Basic pay	Multiply the hours worked by the hourly rate, and by the number of weeks worked if asked about annual pay. We may need to work backwards from annual pay to hourly pay by dividing by weeks and hours worked.			
14.2	Overtime	Time-and-a-half is 1.5 times hourly rate, double time is 2 times hourly rate. **Step 1:** Calculate pay earned from contracted hours. **Step 2:** Calculate overtime pay by calculating hours worked by the relevant additional pay. **Step 3:** Calculate gross pay by adding the two quantities together.			

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14.3	Commission	Commission is paid based upon an employee’s performance or ability to achieve set targets. **Step 1:** Calculate regular salary based on information given. **Step 2:** Calculate the commission, usually calculated as a percentage of the sales completed. **Step 3:** Calculate gross pay by adding the two quantities together.			
14.4	Benefits and allowances	Benefits are payments made by the government for many reasons. Allowances are payments made by the employer for many reasons. **Step 1:** Calculate regular salary based on information given. **Step 2:** Calculate any benefit or allowances. **Step 3:** Calculate gross pay by adding the two quantities together.			
15	**Deductions**				
15.1	National Insurance	**Annual Income** £0 to £12 570 0% From £12 570 to £50 270 12% More than £50 270 2% **Step 1:** Calculate the amount to charge National Insurance by subtracting £12 570 from the employee’s salary. **Step 2:** Calculate annual National Insurance by finding 12% of the salary from £12 570 to £50 270. Find 2% of any salary over £50 270.			
15.2	Income tax	Income tax in the UK, excluding Scotland, for 2024/25 is detailed below: **Band** – **Taxable Income** – **Tax rate** Personal allowance – Up to £12 570 – 0% Basic rate – £12 571 to £50 270 – 20% Higher rate – £50 271 to £125 140 – 40% Additional rate – over £125 140 – 45% **Step 1:** Calculate the amount to charge Income Tax by subtracting £12 570 from the employee’s salary. **Step 2:** Calculate Income Tax by finding 20% of the salary from £12 571 to £50 270. Find 40% of salary from £50 271 to £125 140, and 45% on anything over £125 140.			
15.3	Pension contributions	Employees pay a percentage of their pre-tax salary into a pension and the employer will also pay a percent into the pension. Calculate the pension contribution by calculating the given percentage of the employee's salary.			
16	**Net Pay and Payslips**				
16.1	Calculating net pay	Net pay is what an employee is left with after all deductions have been taken, also referred to as tax home pay. **Step 1:** Total the employee’s deductions. **Step 2:** Calculate the net annual pay by subtracting the deductions from the salary. **Step 3:** Calculate the net monthly pay by dividing the annual pay by 12.			
16.2	Payslips	**NB:** the employee’s tax code is their personal allowance divided by 10 e.g. 1257L = £12 570 tax free pay. We must be able to pick out important information from the employee’s payslip and complete calculations based upon the information given.			

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17	**Savings and Borrowing**				
17.1	Savings	**Step 1:** Calculate the percentage multiplier as a decimal (section 5.9). **Step 2:** Calculate the value in the account after the given period by multiplying the savings by the multiplier raised to the power of the given period (i.e. 3 years = power of 3, etc.) **Step 3:** Calculate the interest earned by subtracting the original savings account value from the value after the given period.			
17.2	Borrowing	**Step 1:** Calculate the loan and interest % as a decimal (section 5.9). **Step 2:** Calculate the loan and interest by multiplying the loan amount by the multiplier. **Step 3:** Calculate the cost of the loan. Divide by number of monthly payments if asked.			
17.3	Simple interest loans	On occasion loans are calculated using simple interest, meaning the interest paid is only on the amount borrowed. **Step 1:** Change the interest percentage to a decimal (÷ 100) **Step 2:** Calculate the cost of the loan by multiplying the loan amount by the percentage and the given period.			
18	**Budgeting**				
18.2	Event planning	Event planning can mean planning any sort of event, trip, holiday etc – we need to know how much money we are required to spend, and how much each individual aspect of the event will cost. Pay attention to the details given: costs per item or per person, capacities for venues etc. Calculate the total cost of the event, ensuring to stick to the budget.			
18.3	Managing incomings and outgoing	Total the income (salary or other sources of income and benefits) and subtract any outgoings (bills, housing, clothing, food etc). If there is money leftover there is a surplus. If we have overspent, there is a deficit.			
18.4	Finding the best value	**Worked Example:** In the supermarket, a bag of six conference pears costs £1.50, another bag of 10 costs £2.49. Which bag offers the best value? Justify your answer by calculation. **Solution:** **Step 1:** Find the cost of 1 pear in each bag. The cheaper apple offers better value. 1.50 ÷ 6 = £0.25 and 2.49 ÷ 10 = £0.249 **Step 2:** Compare prices. 24.9p < 25p **Step 3:** Answer question. The bag of ten pears is better value.			
19	**Statistics**				
19.2	The median	The median is the middle number in an ordered set of data. **Step 1:** Put the data in order from smallest to largest. **Step 2:** Identify the middle number. If the middle lies between two numbers, add them together and divide by two.			
19.3	The mode	The mode is the most common number in a set of data. It tells us what is happening most often in the data. There can be one, many or zero mode(s).			

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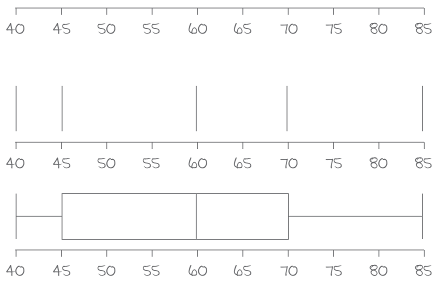
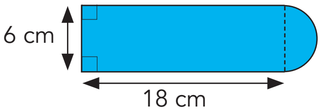
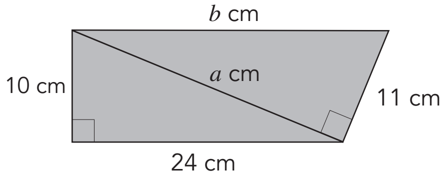
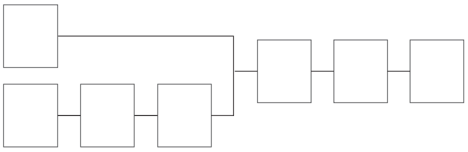
19.5	The five-figure summary	The quartiles, lowest value and highest value form the Five Figure Summary of a data set. Quartiles are values which split a set of data into four equal parts. The median is Q_2. The lower quartile, Q_1, is the median of the left half of the data and the upper quartile, Q_3, is the median of the right half of the data. **Worked Example:** Produce a five-figure summary of the following data: 5 9 11 2 4 6 **Solution:** **Step 1:** Put the data in order from smallest to largest. ~~5~~ ~~9~~ ~~11~~ ~~2~~ ~~4~~ ~~6~~ 2 4 5 6 9 11 **Step 2:** Identify Q_2, and then Q_1 and Q_3 2 ④ 5 | 6 ⑨ 11 $Q_2 = \frac{5+6}{2} = 5.5$ $Q_1 = 4$, $Q_3 = 9$ **Step 3:** List the five-figure summary. $L = 2$, $Q_1 = 4$, $Q_2 = 5.5$, $Q_3 = 9$, $H = 9$			
19.6	Box plots	A box plot is a method of displaying data by its quartiles after producing the five-figure summary. To draw a box plot: **Step 1:** Produce a five-figure summary of the data (see 19.5). **Step 2:** Select a suitable scale according to the five-figure summary. The scale does no need to start at zero but include units. **Step 3:** Draw a vertical line at each point of the five-figure summary. **Step 4:** Draw the horizontal lines to complete the box plot. $L = 40$, $Q_1 = 45$, $Q_2 = 60$, $Q_3 = 70$, $H = 85$ 			
19.7	The interquartile range	Interquartile range (IQR) = $Q_3 - Q_1$ **Worked Example:** Find the interquartile range of the following data: 11 14 8 6 4 9 **Solution:** Write in order and identify quartiles: ~~11~~ ~~14~~ ~~8~~ ~~6~~ ~~4~~ ~~9~~ 4 ⑥ 8 | 9 ⑪ 14 $Q_1 = 6$ $Q_2 = \frac{8+9}{2} = 8.5$ $Q_3 = 11$ $IQR = Q_3 - Q_1$ $= 11 - 6$ $= 5$			

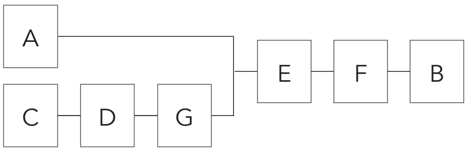
<table>
<tr><th>Section</th><th>Topic</th><th>Skills</th><th>🟥</th><th>🟨</th><th>🟩</th></tr>
<tr><td>19.8</td><td>Standard deviation</td><td>When using either formula, calculate the mean ($\overline{x}$), then draw a table to calculate the values. Finally substitute into the formula.
Worked Example:
Calculate the mean and standard deviation of the following data:
18 20 19 23
Solution:
$x = 20$
<table>
<tr><th>x</th><th>$(x-\overline{x})$</th><th>$(x-\overline{x})^2$</th></tr>
<tr><td>18</td><td>-2</td><td>4</td></tr>
<tr><td>20</td><td>0</td><td>0</td></tr>
<tr><td>19</td><td>-1</td><td>1</td></tr>
<tr><td>23</td><td>3</td><td>9</td></tr>
</table>
$\sum(x-\overline{x})^2 = 14$
$s = \sqrt{\frac{14}{3}}$
s = 2.16 (2 d.p.)</td><td></td><td></td><td></td></tr>
<tr><td>19.9</td><td>Comparing data</td><td>There are two things to compare when comparing two or more sets of data: the average and the spread of the data. The average is either the mean or the median and the spread is either the interquartile range or the standard deviation.
Comparing the average:
We must use the phrase “on average”, state which set of data is higher (or lower) and compare numerically with the appropriate inequality sign.
Comparing the spread:
We must use the phrase “more varied” or “less varied” with a numerical comparison using the appropriate inequality sign: lower interquartile range or lower standard deviation means less varied.</td><td></td><td></td><td></td></tr>
<tr><td>19.10</td><td>Pie charts</td><td>Pie charts are a method of displaying information graphically, represented by pieces of a pie. Pie charts give a very clear indication of the proportions of the data belonging to each category, but they do not necessarily provide any other specific numerical information relating to the data.</td><td></td><td></td><td></td></tr>
<tr><td>19.11</td><td>Scattergraphs</td><td>To construct a scattergraph, pick a suitable scale and plot each piece of information on a graph with each axis representing one piece of information about the data.
Step 1: Look at the lowest and highest values and draw a scale that includes them. It does not need to start at zero.
Step 2: Label the axes.
Step 3: Mark each point with a cross.
A trend in the data is described as the correlation.
If the points are close together and sloping upwards: positive correlation
If the points are close together and sloping downwards: negative correlation
If the points are scattered all over the graph: no correlation</td><td></td><td></td><td></td></tr>
</table>

Section	Topic	Skills	🟥	🟨	🟩
19.12	Drawing the line of best fit	**Step 1:** Put your ruler on its edge over the scattergraph and move it until it looks to be going in the same direction as the trend of the points. They should be close to the line. **Step 2:** Count the points above and below the ruler and move it until there are roughly the same number of points above and below the ruler. **Step 3:** Draw the line on the scattergraph.			
19.13	Using the line of best fit	We can use our line of best fit to estimate one variable if we know the value of the other. **Step 1:** Identify the value of the variable given on the relevant axis. **Step 2:** Trace this value up to the line of best fit and find where it meets the other axis. **Step 3:** Answer the question: approximate answer is required if the estimate does not lie exactly on a number on the axis.			
21	**Area and Perimeter**				
21.3	Converting area units	When converting area units, remember area is two-dimensional and measured in squares: there are 100 square millimetres in 1 square centimetre. We need to convert the linear units in both directions. **Larger to smaller unit** — **Multiply** cm^2 to mm^2 — × 100 m^2 to cm^2 — × 10 000 km^2 to m^2 — × 1 000 000 m^2 to mm^2 — × 1 000 000 Divide to go from smaller to larger unit as per the above table.			
21.9	The area of composite shapes	Composite shapes are made up of two or more 2D shapes. To find the area of composite shapes, find the area of each shape and add them together.			
21.10	The perimeter of composite shapes	The perimeter of a two-dimensional shape is the distance around the boundary of the shape. To find the perimeter of a composite shape, we need to add up the lengths of all the external sides. **Worked Example:** Calculate the perimeter of the shape shown.  **Solution:** Perimeter $= \pi D \div 2 + 18 + 6 + 18$ $= (\pi \times 6) \div 2 + 18 + 6 + 18$ $= 51.42477796\ldots$ $= 51.4$ cm (1 d.p.)			
22	**Volume of Solids**				
22.3	The volume of a cylinder	$V = \pi r^2 h$ Substitute radius and height into formula and calculate.			
22.4	The volume of a cone	$V = \frac{1}{3}\pi r^2 h$ Substitute radius and height into formula and calculate.			
22.5	The volume of a sphere	$V = \frac{4}{3}\pi r^3$ Substitute radius into formula and calculate.			
22.6	The volume of composite solids	Composite solids are made up of two or more solids. To find the volume of composite solids, find the volume of each solid and add them together.			

Section	Topic	Skills	🟥	🟨	🟩
22.7	Volume and capacity units	To convert volume to capacity units, first convert the volume units to cubic centimetres, as 1 cm^3 = 1 ml. **Volume unit conversions** m^3 to cm^3 (× 1 000 000) mm^3 to cm^3 (÷ 1000) **Volume to capacity unit conversations** litres to ml (× 1000) ml to litres (÷ 1000)			
23	**Gradients**				
23.1	Basic gradients	The gradient of a line measures the slop of the line. Gradient is represented by the letter *m* and is calculated as: $\textbf{Gradient} = \frac{\textbf{vertical height}}{\textbf{horizontal distance}}$			
23.2	Gradients from coordinates	Remember that gradient is represented by the letter m. **Step 1:** Select the two coordinates. **Step 2:** Identify the horizontal and vertical differences. **Step 3:** Calculate the gradient using $\mathbf{m} = \frac{\mathbf{V}}{\mathbf{H}}$			
24	**Using Pythagoras Theorem**				
24.1	Squaring and finding the square root of numbers	To calculate a side of a right-angled triangle, it is important to be able to square and square root numbers. **Worked Example:** $x^2 = 17^2 - 4^2$ $x^2 = 289^2 - 16$ $x^2 = 273$ $x = 16.522...$ $x = 16.5$ (1 d.p.)			
24.5	Using Pythagoras' Theorem	For National 5 Applications of Mathematics, Pythagoras Theorem is normally used within a context and often within a two-stage calculation. In the diagram below, it is necessary to use Pythagoras' Theorem to calculate *a* cm and use the answer to calculate *b* cm.  			
25	**Scale Drawing**				
25.2	Using distances to calculate scale factor	**Step 1:** Express the two lengths (real-life and map distances) given as a ratio. **Step 2:** Convert the lengths into the same unit. **Step 3:** Simplify the ratio.			
25.3	Measuring bearings	To measure a bearing from one location to another: **Step 1:** Place the crosshairs of the protractor over the starting location, with the zero line along the North arrow. **Step 2:** Measure clockwise from zero.			
25.4	Making scale drawings from sketches	**Step 1:** Convert the real-life distances to cm. **Step 2:** Draw the shape accurate with a ruler.			
25.5	Making scale drawings with bearings and lines	**Step 1:** Convert the real-life distance to cm. **Step 2:** Mark your starting point and draw a North arrow. **Step 3:** Measure the given bearing using a protractor and mark the angle. **Step 4:** Complete the sketch by accurately drawing the lengths given.			

<table>
<tr><th>Section</th><th>Topic</th><th>Skills</th><th>🟥</th><th>🟨</th><th>🟩</th></tr>
<tr><td>26</td><td>Time Management</td><td></td><td></td><td></td><td></td></tr>
<tr><td>26.1</td><td>Crossing time zones</td><td>
Worked Example:
A plane takes off from Bangkok at 16:42 and arrives in London 11 hours and 30 minutes later. Bangkok is 7 hours ahead of London. What time does the plane arrive in London?
Step 1: Work out the departure time in London.
16:42 – 7 hours → 09:42
Step 2: Add on flight time.


The plane arrives in London at 21:12.
</td><td></td><td></td><td></td></tr>
<tr><td>26.2</td><td>Using precedence tables</td><td>
We will be given a list of steps required to undertake for a certain task and how long they will take. We must put them in the correct order so that any preceding tasks are in the correct position. The quickest time to complete a task is called the critical path.
Worked Example:
David is cooking burgers on the barbecue. The table below shows the list of tasks required to complete this.
<table>
<tr><th>Activity</th><th>Description</th><th>Preceding task</th><th>Time</th></tr>
<tr><td>A</td><td>Season the burgers</td><td>None</td><td>3 mins</td></tr>
<tr><td>B</td><td>Turn off gas</td><td>F</td><td>2 mins</td></tr>
<tr><td>C</td><td>Get BBQ out of garage</td><td>None</td><td>5 mins</td></tr>
<tr><td>D</td><td>Attach gas to BBQ</td><td>C</td><td>4 mins</td></tr>
<tr><td>E</td><td>Place burgers on the grill</td><td>G, A</td><td>2 mins</td></tr>
<tr><td>F</td><td>Take burgers off after cooking</td><td>E</td><td>6 mins</td></tr>
<tr><td>G</td><td>Light BBQ</td><td>D</td><td>2 mins</td></tr>
</table>
(a) Complete the diagram below to show the tasks in the correct order:

(b) From the times taken calculate the quickest possible time to cook the burgers.

Solution:
(a)


(b) Add the times for each task. To identify the critical path, add the longest of two tasks which can happen simultaneously as the shorter task can also be completed in this time.

5 + 4 + 2 + 2 + 6 + 2 = 21 min

Answer: Total time to cook burgers is 21 minutes.
</td><td></td><td></td><td></td></tr>
</table>

Section	Topic	Skills	🟥	🟨	🟩
27	**Tolerance**				
27.1	Using tolerance to calculate the limits	**Worked Example:** Calculate the upper and lower limits of the measurement with the given tolerances: 140mph ± 2.4% 2.4% of 140 = 3.36mph Upper limit = 140 + 3.36mph = 143.36mph Lower limit = 140 – 3.36mph = 136.64mph			
27.2	Using limits to calculate the tolerance	**Worked Example:** Given a lower limit of 382 ml and an upper limit of 434 ml, express the measurements in tolerance notation. State the tolerance as a percentage. **Step 1:** Calculate the range. 434 – 382 = 52 ml **Step 2:** Half the range. 52 ÷ 2 = 26 ml **Step 3:** Add to lower limit. 382 + 26 = 408 ml **Step 4:** Calculate percentage. 26 ÷ 408 × 100 = 6% **Step 5:** State with tolerance. 408ml ± 6%			
28	**Container Packing**				
28.1	Container packing with cubes and cuboids	**Worked Example:** How many cubes of side 7 cm can fit into a cuboid with dimensions l = 44 cm, b = 16 cm, h = 18 cm? Work out how many cubes can fit each dimension. **Length:** 44 ÷ 7 = 6.286 → 6 cubes **Breadth:** 16 ÷ 7 = 2.286 → 2 cubes **Height:** 18 ÷ 7 = 2.571 → 2 cubes 6 × 2 × 2 = 24 cubes will fit in the cuboid. **NB:** Truncate the answers, i.e. remove the decimal part, rather than rounding.			
28.2	Container packing with cuboids	**Worked Example:** What is the maximum numbers of cuboids with dimensions l = 20 cm, b = 25 cm, h = 16 cm which can fit into a box with dimensions l = 60 cm, b = 40 cm, h = 50 cm? The boxes must be facing upwards and be aligned in the same direction. **Step 1:** Work out how many cuboids can fit each dimension one way.7 **Length:** 60 ÷ 20 = 3 → 3 cuboids **Breadth:** 40 ÷ 25 = 1.6 → 1 cuboid **Height:** 50 ÷ 16 = 3.125 → 3 cuboids 3 × 1 × 3 = 9 cuboids. **Step 2:** Work out how many cuboids can fit each dimension the other way. **Length:** 60 ÷ 25 = 2.4 → 2 cuboids **Breadth:** 40 ÷ 20 = 2 → 2 cuboids **Height:** 50 ÷ 16 = 3.125 → 3 cuboids 2 × 2 × 3 = 12 cuboids. **Step 3:** Answer. The maximum number of small cuboids that will fit in the large cuboid is 12.			